



Original Research Article

Ethno-Botanical Study of some *Solanum* L. Species with Reference to Foliar Micromorphology and Wood Elements

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ABSTRACT

The present work was undertaken to explore the ethno-botanical resources of Birbhum district of West Bengal as well as to evaluate the epidermal micromorphology and wood element characters of four medicinally important species of the genus *Solanum*. It includes the detailed studies of leaf epidermal micromorphology and stem xylem elements characters of *Solanum nigrum* Linn., *Solanum sisymbriifolium* Lamk., *Solanum torvum* Swartz., and *Solanum viarum* Dunal. The investigations were carried out using the fresh plant parts. The fresh leaf showed the epidermal cells are irregular in shape and the outline of the cells varies from straight to wavy. Stomata are amphistomatic in all the cases and mainly of anisocytic type mixed with few anomocytic stomata. Trichomes are both nonglandular and glandular types. Nonglandular types are unicellular or multicellular, uniseriate or stellate, present in both the epidermal layers. Glandular trichomes are globose, unicellular to multicellular, stalked, present in upper or lower as well as in both surfaces. The range of stomatal index varies from 13 to 22. The palisade ratio varies from 7 to 11. By comparative wood element study of these four taxa, vessels, tracheids and fibres with some distinctive features are also found. The vessel elements number ranges from 11.01 to 33.03 /mm². The number of tracheids varies from 22.02 to 44.05 /mm² and fibres from 33.03 to 66.07 /mm². This study will be very helpful to herbalists and pharmacologists for proper evaluation and validation of folk drug.

Keywords

Solanum sps.,
Stomatal
type,
Stomatal
index,
Palisade
ratio,
Trichomes,
Xylem
elements, etc.

Introduction

With the renewed interest in ethno-botany, the alternative herbal medicines and products are gaining more popularity in recent years. The researchers are interested towards the plants, hitherto unexploited or under exploited, for medicinal purposes taking cue mainly from the Sanskrit-Ayurvedic literature. Several studies on medico-ethnobotany have been carried out

in various parts of India, over the last few decades, emphasizing attention in various tribal inhabited zones because of its relevance to the discovery and development of new or less known medicinal plants.

Ethnobotanical information, whatever is revealed, is largely a part of routine floristic studies in the Santiniketan as well as

Birbhum district. In view of this, the present work was undertaken to explore the ethnobotanical resources of Birbhum district of West Bengal as well as to evaluate the preliminary pharmacognostic characters of some selected medicinal plants from the study sites. For this, epidermal micromorphology and wood element study was carried out. In conformity with the task of stock-taking of the medicinal plants, Birbhum district was chosen from West Bengal since it shows a unique assemblage of components of the state/district flora with many species of aliens, weeds, ornamentals, avenue tree, etc.

Pharmacognosy implies a particular knowledge of methods of identification and evaluation of crude drugs produced from the plants which include morphological, morphoanatomical, microchemical, phytochemical, pharmacological studies of crude drugs. The size, distribution and frequency of stomata have been reported to be specific to a certain taxa (Johansen, 1940; Trease and Evans, 1978, 1983) and these characters are also used as significant parameters in the angiosperm taxonomy as well as phylogeny (Mukherjee *et al.*, 2000; Paliwal 1966; Rajagopal, 1979; Saikia and Dey, 1987). Hence, in the present investigation, the micromorphology leaf epidermis and stem xylem elements characters of four ethnomedicinal species like *Solanum nigrum* Linn., *Solanum sisymbriifolium* Lamk., *Solanum torvum* Swartz. and *Solanum viarum* Dunal of the family Solanaceae has been studied. The family Solanaceae has been studied anatomically by different workers from different viewpoints including foliar epidermal micromorphology (Metcalf and Chalk, 1950). However no study had been done earlier on these plant species, therefore, the present investigation has been under taken to study the foliar epidermal micromorphology and stem xylem elements

characters of the four plant species.

Materials and Methods

Materials

***Solanum nigrum* Linn.:-** It is an annual, sparsely pubescent, unarmed shrub. Flowers are white and small; berry globose, green, small. It naturally grows on moist shady waste places, distributed throughout India, up to 9000 ft in West Himalayas. In Bengali, it is known as-Kakmachi. The active principle is solanine, a saponin compounds present in berries and whole plant. In Yunani system – it is used in diseases of ear and nose, neck ulcer, inflammation of liver, chronic fever, as laxative etc. In Ayurveda system – used in heart disease, leucoderma, asthma, bronchitis, urinary discharges, an aphrodisiac; tonic and improves the appetite etc. Ethnomedicinally used in fever, diarrhea, piles, dysentery, skin disease; as tonic, laxative, diuretic, alternative, etc.

***Solanum torvum* Swartz.:-** A perennial shrub with prickles in stem. Flowers are cream colored; berry small, globose, green. It commonly grows in garden land, waste places and road sides. It is found throughout India in tropical region except in Western Desert area. In Bengali, it is known as – Titabegun, Berry contains sterolin (Satosterol glycoside) and 0.1% solasonine, used in spleen enlargement and in cough. The whole plant is effective pain relifer and appetizer. Root paste is used in foot swelling.

***Solanum sisymbriifolium* Lamk.:-** Flower is white, berry globose, red; commonly grows in the waste places and road side. It is a native plant of Mexico; naturalized in different parts of India. In Bengali, it is commonly known as –sadakantikari or setrangani. It is effective in asthma. Whole plant is used in abdominal pain. Roots are

effective in cough, cold and bronchitis. Roots, leaves and fruits are administered with black pepper to cure pox.

***Solanum viarum* Dunal:** - A perennial shrub with profuse prickles on stems and leaf. Flowers are white and berries are globose, green. Commonly it grows in the garden lands or in waste places. It is present throughout the Eastern to North Eastern Himalayas, Nilgiri Hills and plains of the other states of India. The active principle is 2% solasodine. Berries are used to repel the leaches, in the treatment of tooth-ache, to stupefy the fishes, solasodine is a good source of sex-hormone.

Methods

Intensive field work was conducted for last few years covering all the seasons so as to collect detail information on plant species found useful in ethnomedicine as well as for the other local uses of the plants occurring in Birbhum district, West Bengal. During ethnobotanical surveys, all tribal localities, adjoining forest areas and the plains of the district were visited. Observations were made of the plant species with respect to their location, habit, habitat and other field characters. The collected plant species have been carefully identified with the help of different floras (Panigrahi and Murti, 1989; Hooker, 1896). The collected plant specimens have been preserved as herbarium specimens and kept in the herbarium of the Department of Botany, Visva-Bharati, Santiniketan for future references.

The data on ethnomedicinal uses of plants were collected directly from various tribal medicine men and other knowledgeable persons of the study areas. The tribal medicine men were interviewed repeatedly to collect the first hand information.

The study samples (leaves) were selected from distal, central and proximal areas of the leaves from each investigated taxa. The leaf pieces were treated with Bokhari's (1970) method. The treated leaf samples were then mounted in 10% glycerine with a few drops of 1% aqueous solution of safranin and observed under compound light microscope. For detailed study of wood elements, stems were first cut into pieces and boiled with 10% nitric acid and 10% KOH solution separately for 10 minutes each. Then the treated samples were washed several times in distilled water, macerated and stained with safranin for microscopic observation. The drawings of the leaf epidermal micromorphological characters as well as stem xylem element characters were made with the camera lucida and readings were taken with standardized ocular micrometer in each case. SEM was also done.

Results and Discussion

Solanum nigrum Linn.

Foliar epidermal micromorphology:-

Epidermis: Epidermal cells are irregular in shape and the outlines are strictly wavy on both surfaces. Cell size of the upper epidermis is 89.28 μm x 21.43 μm . Frequency of the upper epidermal cell is 605.00 / mm^2 . Cell size of the lower epidermis is 71.42 μm x 21.43 μm and frequency is 1398.69 / mm^2 . Palisade ratio is 10.90 (Fig. 1A, B, D, E).

Stomatal Complex: Leaves are amphistomatic i.e. stomata are present on both the epidermal layers of the leaf. Anomocytic and anisocytic types of stomata remain mixed on the upper surface. Whereas on the lower surface stomata are strictly anomocytic. Stomatal size of the upper and lower surfaces is 26.58 μm x 17.85 μm and 24.99 μm x 17.85 μm respectively.

Frequency is 55.06 /mm² and 308.37 /mm² on the upper and lower surfaces respectively. Stomatal index is 22.12 (Fig. 1 A, B, D, E).

Trichomes: Nonglandular, uniseriate, multicellular trichomes are present on the both epidermal surfaces. The size and frequency are same in both upper and lower surfaces; size is 339.24 µm x 53.56 µm and frequency is 33.03 /mm². Glandular, multicellular, stalked trichomes of the upper surface having the size of 63.76 µm x 35.27 µm and frequency is 22.02 /mm². Glandular structures are exclusively absent on the lower surface. Trichome index is 02.75 (Fig. 1C, F, G, H, I, J, K).

Xylem elements:

Vessel elements are with simple, transverse or oblique perforation plate; pits are simple and elliptical. Tails are frequently present in the vessel elements; size of the vessel is 112.53 µm x 21.42 µm; frequency is 11.01 /mm² (Fig. 2A).

Tracheids are very long with spiral side wall thickening; diameter is 18.42 µm and frequency is 22.07 /mm² (Fig. 2B).

Fibres are typically libriform type with tapering and pointed ends. Wall is moderately thickened and pits are present near the two ends. Size is 321.00 µm x 17.85 µm and frequency is 66.08 /mm² (Fig. 2C).

***Solanum torvum* Swartz.**

Foliar epidermal micromorphology:

Epidermis: Epidermal cells are irregular in shape and the outlines are strictly wavy on both surfaces of the leaf. Size of the upper epidermal cell is 41.06 µm x 15.47 µm and in the lower surface, size is 71.42 µm x

17.85 µm. Cell frequency is 2473.56 /mm² and 2165.93 /mm² in the upper surface and lower surfaces respectively. Palisade ratio is 06.06 (Fig. 3A, C, D).

Stomatal Complex: Leaves are amphistomatic i.e. stomata are present on both the epidermal layers of the leaf. Stomata of the upper epidermis are strictly anisocytic type and the size of stomata is 19.64 µm x 14.28 µm; frequency is 88.10 /mm². On the lower surface mainly anisocytic stomata are present with few anomocytic type. Size is 19.64 µm x 14.28 µm and frequency is 550.60 /mm². Stomatal index is 18.39 (Fig. 3A, B, C, D).

Trichomes: Nonglandular, stellate trichomes with 3-8 branches are present on both the epidermal surfaces. Nonglandular stellate trichomes having the size of 249.97 µm x 214.26 µm on the upper surface and 357.10 µm x 321.39 µm on the lower surface. Frequency is 22.02 /mm² and 33.03 /mm² on upper and lower surfaces respectively. Glandular, unicellular trichomes with pointed projection are present on the upper surface having the size of 46.42 µm x 42.85 µm and frequency is 22.02 /mm². Glandular, multicellular, globose, stalked structures are present on both the surfaces. The size is 53.56 µm x 21.42 µm and 48.85 µm x 10.61 µm on upper and lower surfaces respectively. Frequency is 22.02 /mm² both on the upper and lower surfaces. On the lower surface unicellular, long, unbranched trichomes are present with bulbous base and pointed apex; size is 92.84 µm x 10.71 µm and frequency is 44.04 /mm². Trichome index is 01.17 (Fig. 3E, F, G, H, I, J, K).

Xylem elements

Vessels having simple, transversely arranged perforation plate. Pits are simple and elliptical. Tails are frequently present

with the vessel elements. Size of the vessel element is $399.96 \mu\text{m} \times 49.94 \mu\text{m}$; frequency is $33.03 / \text{mm}^2$ (Fig. 4A).

Tracheids are very long with spiral sidewall thickening. Diameter is $32.14 \mu\text{m}$ and frequency is $33.03 / \text{mm}^2$ (Fig. 4B).

Fibres are typically libriform type with tapering or blunt ends. Wall thickening is heavy and pits are present throughout the fibre; size is $564.00 \mu\text{m} \times 28.57 \mu\text{m}$ and frequency is $44.05 / \text{mm}^2$ (Fig. 4C, D).

***Solanum sisymbriifolium* Linn.**

Foliar epidermal micromorphology

Epidermis: Epidermal cells are irregular in shape and the outlines are strictly wavy on both surfaces of the leaf. The size of the upper epidermal cells is $58.33 \mu\text{m} \times 26.78 \mu\text{m}$ and on the lower surface, the size is $58.33 \mu\text{m} \times 35.71 \mu\text{m}$. Cell frequency is $1376.66 / \text{mm}^2$ and $2099.85 / \text{mm}^2$ on the upper and lower surfaces respectively. Palisade ratio is 09.73 (Fig. 5A, B, C, D, E).

Stomatal complex: Leaves are amphistomatic i.e. stomata are present on both the epidermal layers of leaf. Stomata on both the surfaces are mainly anisocytic type with few anomocytic types. Stomatal size of the upper epidermis is $28.56 \mu\text{m} \times 17.85 \mu\text{m}$; stomatal frequency is $192.78 / \text{mm}^2$. Size and frequency of the stomata on lower surface are $24.99 \mu\text{m} \times 17.85 \mu\text{m}$ and $418.50 / \text{mm}^2$ respectively. Stomatal index is 16.61 (Fig. 5A, B, C, D, E).

Trichomes: Nonglandular, stellate trichomes with 3-7 branches are present on both the leaf surfaces. The size is $392.81 \mu\text{m} \times 295.68 \mu\text{m}$ on upper surface and on the lower surface it is $380.72 \mu\text{m} \times 255.71 \mu\text{m}$. Frequency of this type of trichomes on both

the surfaces is $11.01 / \text{mm}^2$. Nonglandular, unicellular trichomes with bulbous base are present on both surfaces and their size is $214.26 \mu\text{m} \times 13.09 \mu\text{m}$ and $78.56 \mu\text{m} \times 10.12 \mu\text{m}$ on the upper and lower surfaces respectively. Frequency is $22.02 / \text{mm}^2$ on the upper surface and $11.01 / \text{mm}^2$ on the lower surface. The glandular, multicellular, stalked globose trichomes are found on both surfaces and their size is $321.39 \mu\text{m} \times 27.37 \mu\text{m}$ on the upper surface and $247.97 \mu\text{m} \times 25.59 \mu\text{m}$ on the lower surface. The frequency is $33.03 / \text{mm}^2$ on upper surface and $55.05 / \text{mm}^2$ on lower surface. The glandular, bi-celled, globose, stalked structures are present on the both surfaces. The size and frequency are $49.99 \mu\text{m} \times 20.53 \mu\text{m}$ and $11.01 / \text{mm}^2$ in the upper surface and $49.99 \mu\text{m} \times 21.42 \mu\text{m}$ and $22.02 / \text{mm}^2$ in the lower surface. Trichome index is 01.25 (Fig. 5F, G, H, I, J, K, L, M, N, O).

Xylem elements:- Vessels are with simple and transversely arranged perforation plate; pits are simple and elliptical. Tails are sometimes present. Size of the vessel is $285.69 \mu\text{m} \times 42.85 \mu\text{m}$; frequency is $22.03 / \text{mm}^2$ (Fig. 6A).

Tracheids are very long and spirally thickened. Diameter is $41.07 \mu\text{m}$ and frequency is $33.03 / \text{mm}^2$ (Fig. 6B).

Fibres are typically libriform type with narrow, tapering ends. Wall is lesser in thickness and pits are present throughout the fibre. Size and frequency of the fibre are $432.00 \mu\text{m} \times 21.42 \mu\text{m}$ and $49.56 / \text{mm}^2$ respectively (Fig. 6C, D, E).

***Solanum viarum* Dunal**

Foliar epidermal micromorphology

Epidermis: Epidermal cells are irregular in shape and the outlines are strictly wavy on

the both surfaces. The upper epidermal cell size is $82.13 \mu\text{m} \times 21.42 \mu\text{m}$; frequency is $2973.56 /\text{mm}^2$. Cell size of the lower epidermis is $62.49 \mu\text{m} \times 21.42 \mu\text{m}$ and frequency is $2165.93 /\text{mm}^2$. Palisade ratio is 09.69 (Fig. 7A, B, C, N).

Stomatal Complex: Leaves are amphistomatic i.e. stomata are present on both the epidermal layers of the leaf. Stomata are mainly anisocytic with some anomocytic type on the upper surface and on the lower surface mainly anisocytic stomata are mixed with anomocytic and diacytic types. Stomatal size is $17.85 \mu\text{m} \times 14.28 \mu\text{m}$ on upper surface and on the lower surface the size is $28.56 \mu\text{m} \times 17.85 \mu\text{m}$. Stomatal frequency is $187.59 /\text{mm}^2$ and $381.58 /\text{mm}^2$ on upper and lower surfaces respectively. Stomatal index is 12.78 (Fig. 7A, B, C, D).

Trichomes: Nonglandular, multicellular, uniseriate trichomes with bulbous base and pointed apex and stellate, 5-branched, nonglandular trichomes are found on both the surfaces. On the upper surface size is $357.10 \mu\text{m} \times 15.47 \mu\text{m}$; on lower surface size is $357.10 \mu\text{m} \times 27.37 \mu\text{m}$. Frequency on the upper surface is $55.06 /\text{mm}^2$ and on the lower surface it is $49.55 /\text{mm}^2$. The glandular, uniseriate, multicellular trichomes with bulbous base are found on the both surfaces and the size is $214.26 \mu\text{m} \times 26.18 \mu\text{m}$ and $303.53 \mu\text{m} \times 26.78 \mu\text{m}$ in upper and lower surfaces respectively. Frequency of this trichome varies from $44.05 /\text{mm}^2$ to $38.54 /\text{mm}^2$ on the upper and lower surfaces respectively. Glandular, bicellular, globose, stalked trichomes are also observed in both surfaces. The size of this type of trichome is $74.99 \mu\text{m} \times 24.99 \mu\text{m}$ and frequency is $60.57 /\text{mm}^2$ in the upper surface. The size of trichome in lower surface is $89.27 \mu\text{m} \times 39.28 \mu\text{m}$ and frequency is $33.03/\text{mm}^2$. Trichome index of nonglandular, multicellular, uniseriate type is 01.79 (Fig. 7E, F, G, H, I, J, K, L, M, O, P).

Xylem elements:- Perforation plates of the vessel elements are simple, transverse and obliquely placed. Pits are simple and elliptical; tails are sometimes present with the vessel elements. Size is $428.52 \mu\text{m} \times 42.85 \mu\text{m}$ and frequency is $22.03 /\text{mm}^2$ (Fig. 8A, B).

Tracheids are very long with spiral side wall thickening. Diameter is $42.85 \mu\text{m}$ and frequency is $44.45 /\text{mm}^2$ (Fig. 8C).

Fibres are typically libriform type with tapering and pointed ends; wall thickening is medium and simple narrow pits are present throughout the fibre. Size is $601.00 \mu\text{m} \times 30.35 \mu\text{m}$ and frequency is $33.04 /\text{mm}^2$ (Fig. 8D).

Key to the investigated taxa:

Uniseriate, multicellular, nonglandular trichomes present on both surfaces:

Mostly anisocytic mixed with anomocytic stomata on both surfaces; stomatal index – 13.

Solanum viarum

Strictly anomocytic stomata on the lower surface; stomatal index – 22

Solanum nigrum

Staellatic 3 – 8 branched nonglandular trichomes present on both surfaces:

Mostly anisocytic mixed with anomocytic stomata on both surfaces; palisaderatio – 10.

Solanum sisymbriifolium

Strictly anisocytic stomata present on the upper epidermis; palisade ratio – 7.

Solanum torvum

The size, distribution and frequency of stomata have been reported to be specific to a certain taxa and hence by these study the

crude drugs as well as adulterants are easily be recognised (Johansen, 1940; Trease and Evans, 1978, 1983) and these characters are also used as significant parameters in the angiosperm taxonomy as well as phylogeny (Mukherjee *et al.*, 2000; Paliwal 1966; Rajagopal, 1979; Saikia and Dey, 1987). Solanaceae is a large family of angiosperm and has been anatomically studied by different workers from different viewpoints (Bose and Ghosh, 1980; Nadkarni, 1992), but little work has been performed in the pharmacognostic view points of this family in respect to foliar epidermal micromorphology. Stem xylem characters are also very important for identifying markers at inter- generic and inter -specific levels (Chaturvedi, 1995). Perforated end walls (Meylon and Butter field, 1981) are simple in all the fast and slow growing species studied, which may be regarded as a phylogenetically advanced character (Metcalfe and Chalk, 1950, Samant and Shete, 1988). Naik and Bhogaonkar (2002) showed that the vessel elements vary characteristically in their length and breadth in different species, thus enabling interpretation of their taxonomy and phylogeny. Fibre also possesses some species specific characters.

The present investigation has been undertaken to study the foliar epidermal micromorphological features and stem xylem element characters of some medicinally important species of *Solanum*, shows some distinctive characters. Palisade ratio varies from 7 to 11 in *S. torvum* and *S. nigrum*. Stomatal size of the upper epidermis ranges from 17.85 x 14.28µm to 28.56 µm x 17.85 µm in *S. viarum* and lowest (19.64 x 14.28µm) in *S. torvum*. Stomatal frequency ranges from 55.06 / mm² to 192.73 / mm² in *S. nigrum* and *S. sisymbriifolium* on the upper surface and on the lower surface, it ranges from 308.37 / mm² to 550.60 / mm² in *S. nigrum* and *S.*

torvum. Stomatal index is highest (22) in *S. nigrum* and lowest (13) in *S. viarum*. Trichomes are of various types, nonglandular, uniseriate, multicellular with bulbous base and pointed apex is present on both the surfaces of *S. viarum*. Trichome frequency ranges from 33.03 / mm² to 55.06 / mm² on the upper surface of *S. nigrum* and *S. viarum* and on the lower surface, it ranges from 30.03/mm² in *S. nigrum* to 49.55 /mm² in *S. viarum*. Nonglandular, stellate, many branched trichomes are present on both the surfaces of *S. viarum*, *S. sisymbriifolium* and *S. torvum*. On the upper surface, size ranges from 392.81 µm x 285.68 µm in *S. sisymbriifolium* to 249.97 µm x 234.26 µm in *S. torvum*. On the lower surface, it ranges from 380.72 µm x 255.71 µm in *S. sisymbriifolium* to 321.39 µm x 357.1 µm in *S. torvum*. Frequency varies from 11.03 / mm² to 22.02 /mm² on the upper surface of *S. sisymbriifolium* and *S. torvum*. Nonglandular, unicellular with bulbous based trichomes also present on both the surfaces of *S. sisymbriifolium* and lower surface of *S. torvum*. Glandular trichomes are of two types; glandular, multicellular, stalked are present on the both surfaces of *S. khasianum*, *S. Sisymbriifolium*, *S. torvum* and the upper surface of *S. nigrum*. Glandular, unicellular, globose, stalked are present in the two surfaces of *S. khasianum* and *S. sisymbriifolium* and upper surface of *S. torvum*. Glandular structures are strictly absent on the lower surface of *S. nigrum*. The highest (285.69x42.85µm) sized vessel is found on *S. sisymbriifolium* and lowest (112.53x21.42µm) found in *S. nigrum*. Frequency of the vessel is highest (33.03 / mm²) in *S. torvum* and lowest (11.01 / mm²) in *S. nigrum*. Diameter of the tracheid is largest (42.85 µm) in *S. viarum* and lowest (18.42µm) in *S. nigrum*. Frequency ranges from 22.07 / mm² to 44.05 / mm² in *S. nigrum* to *S. viarum*. Pittations are present throughout the fibre or only on the ending

(*S. nigrum*). Diameter varies from 17.85 μm to 30.35 μm in *S. nigrum* to *S. viarum*; frequency ranges from 33.04 / mm^2 in *S. viarum* to 66.08 / mm^2 in *S. nigrum*.

This study will contribute some investigations as well as data in the pharmacognostic filed of Indian Science. Finally, this will be very helpful in proper

identification of crude drugs obtained from this four investigated species and also be used in detection of drug adulterants. Lastly the investigation will prepare the district inventory of ethnobotany for Birbhum district of West Bengal, which will ultimately be the building blocks for state level inventory.

Photographs of the investigated plants

Solanum nigrum Linn.



Solanum sisymbriifolium Lamk.



Solanum torvum Swartz.



Solanum viarum Dunal



Fig.1 Epidermal micromorphology: A, B, D- Anomocytic Stomata; E- Anisocytic and Anomocytic Stomata; C- Multicellular Stalked Gland; F, J-Glandular and Nonglandular Trichomes; G, H, I, K- Nonglandular Trichomes

Solanum nigrum Linn

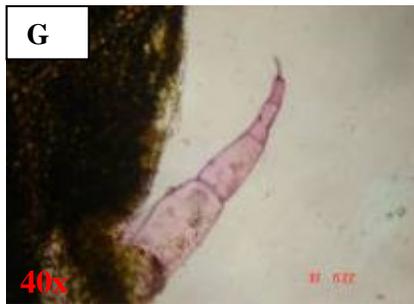
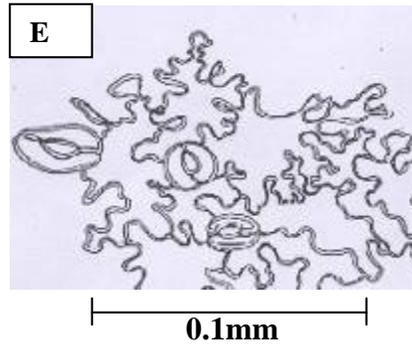
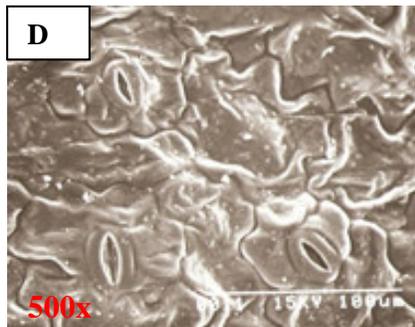
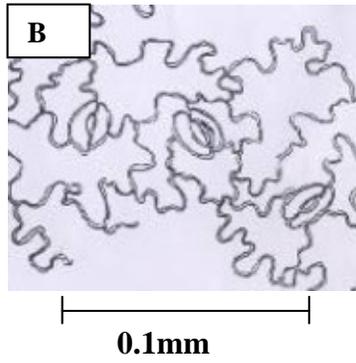
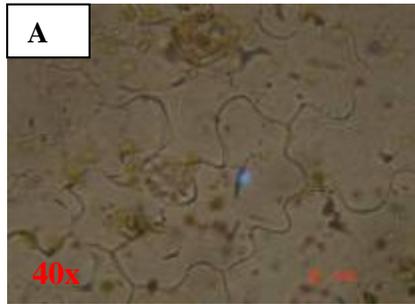


Fig.2 Wood elements: A- A Portion of Vessel Element; B- A Portion of Tracheid; C- A Portion of Fibre

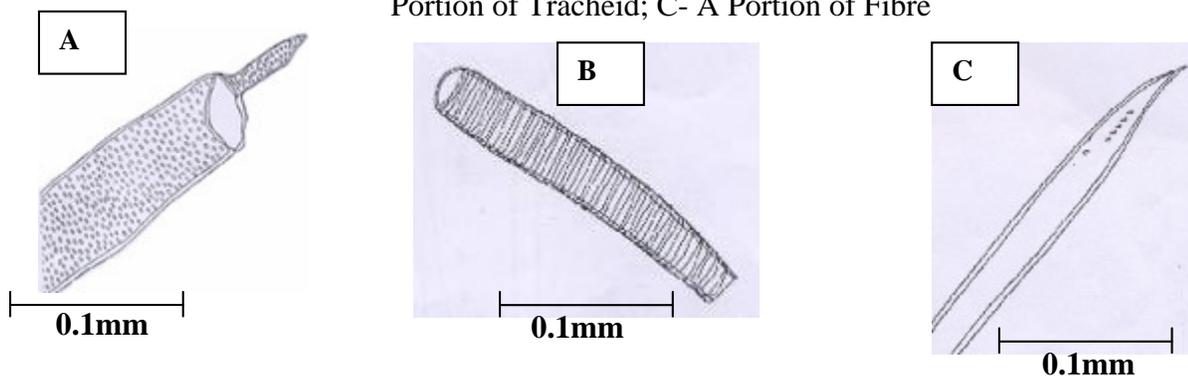


Fig.3 Epidermal micromorphology: A, B, C, D, E- Anomo and Anisocytic Stomata; F- Glandular and Nonglandular Trichomes; G, H- Nonglandular Uniseriate and Stellate Trichomes; I, J- Nonglandular, Unicellular Trichomes; K, O- Glandular, Multicellular Trichomes; L, M- Stalked Glands; N- Stellate Trichome

Solanum sisymbriifolium Lamk.

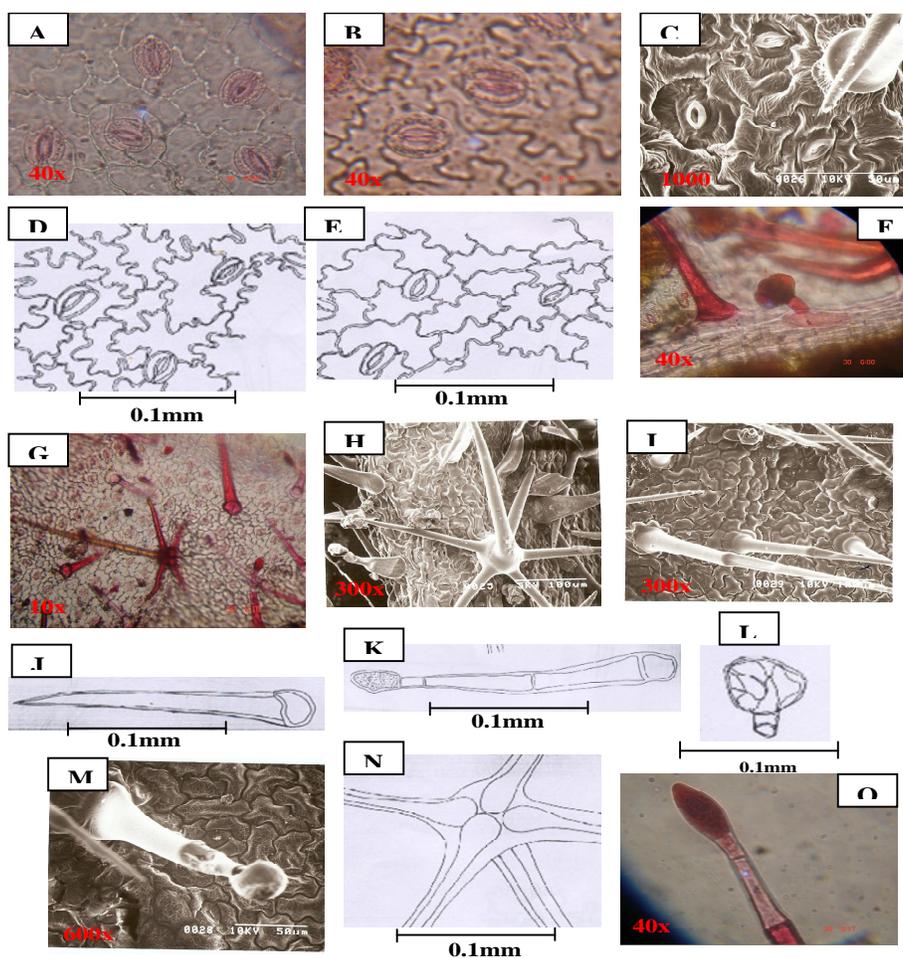


Fig.4 Wood elements: A - Vessel Element; B- A Portion of Tracheid; C, D, E- Portion of Fibres

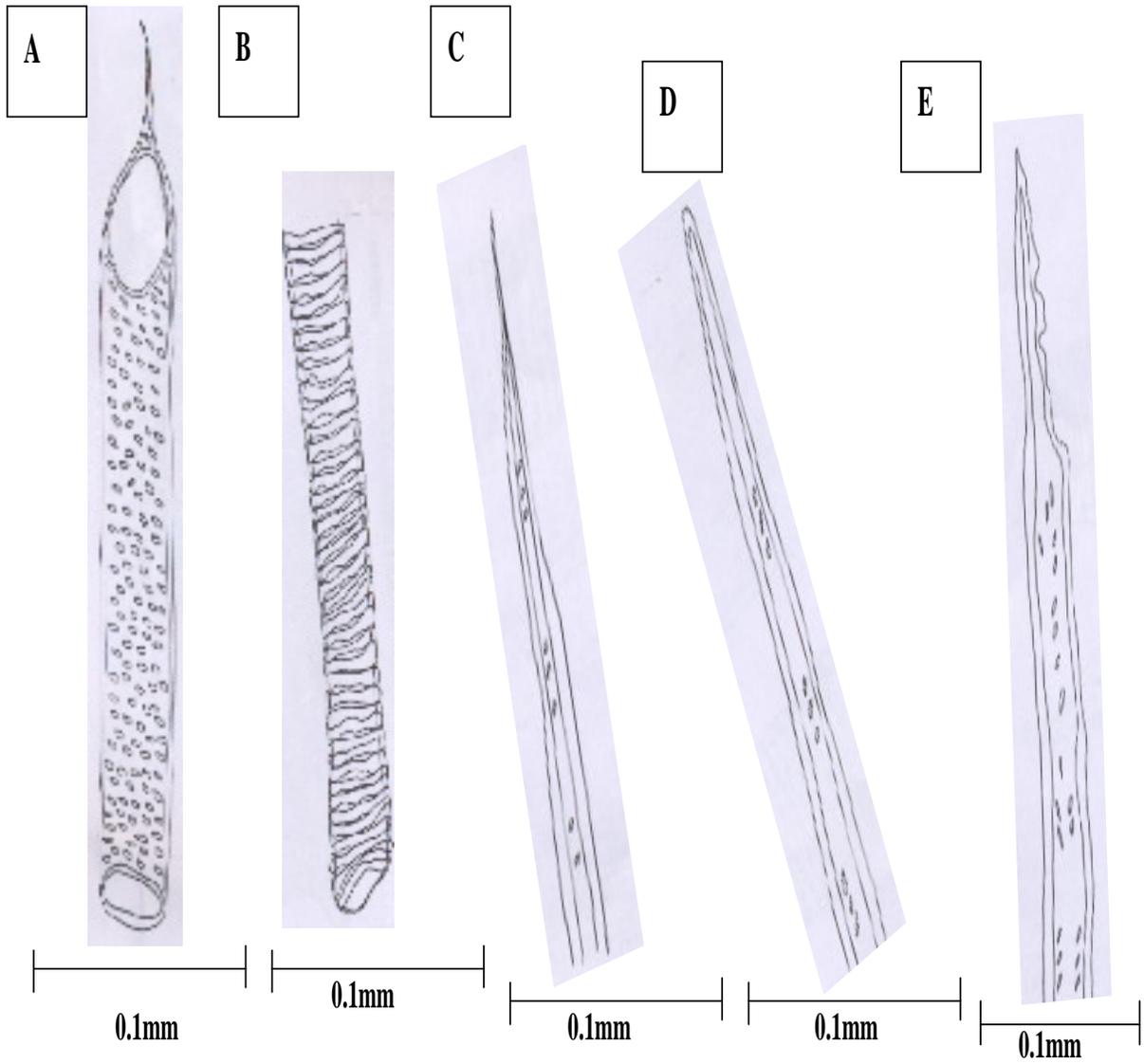


Fig.5 Epidermal micromorphology: A, B, C, D- Anomo and Anisocytic Stomata; E- Glandular and Nonglandular Trichomes; F, I, J- Nonglandular Stellate Trichomes; G, H- Nonglandular Unicellular Trichomes; K- Multicellular Stalked Gland

***Solanum torvum* Swartz.**

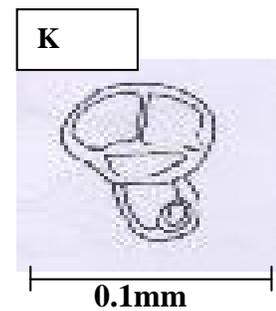
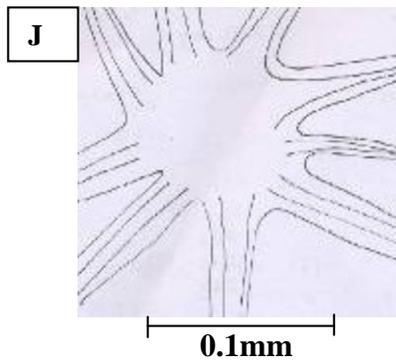
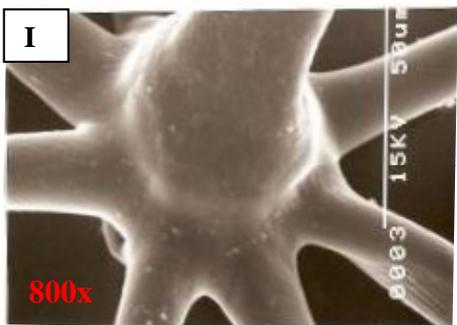
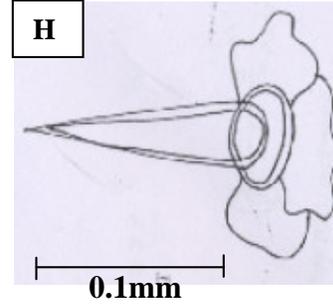
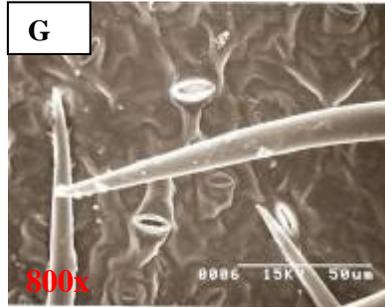
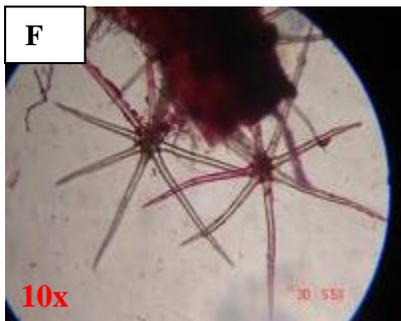
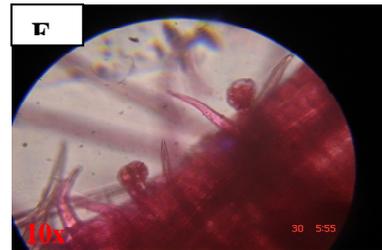
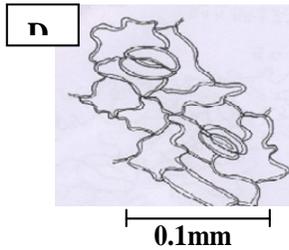
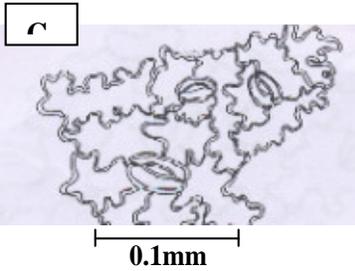
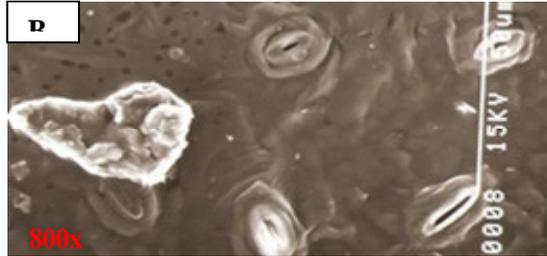
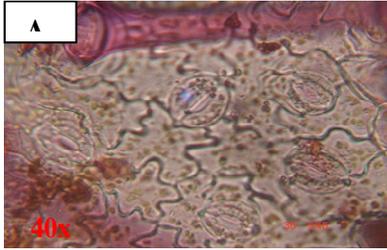


Fig.6 Wood elements: A - Vessel Element; B- A Portion of Tracheid; C, D- Portion of Fibres

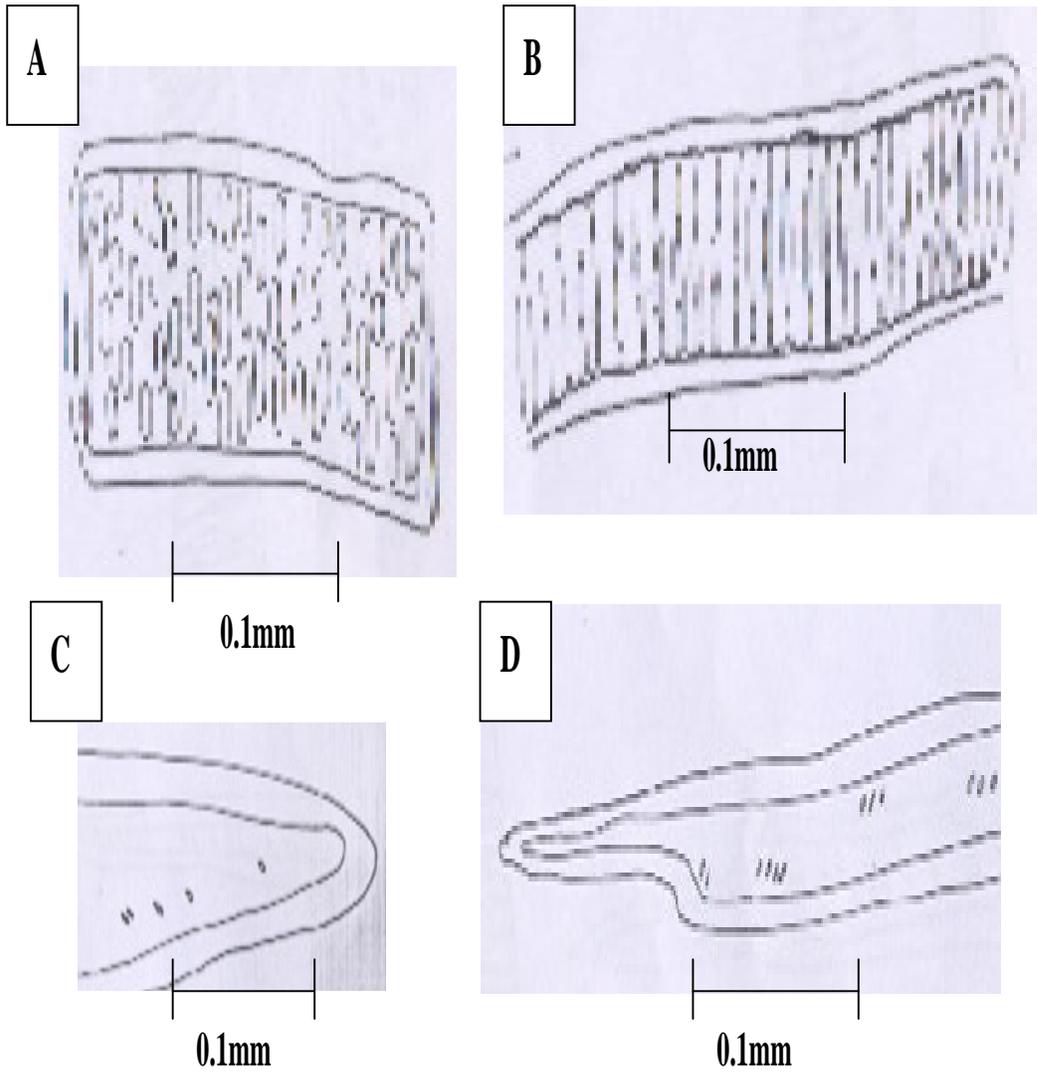


Fig.7 Epidermal micromorphology: A, B, C- Anomocytic, Anisocytic and Diacytic Stomata; D- Single Stoma; E- Glandular Trichome; F, G, I- Glandular and Nonglandular Trichomes; H - Nonglandular Trichome; J, K, L- Nonglandular Stellate Trichomes; M- Nonglandular Trichome with wide base; N, P- Bicellular Stalked Glands; O- Multicellular Stalked Gland

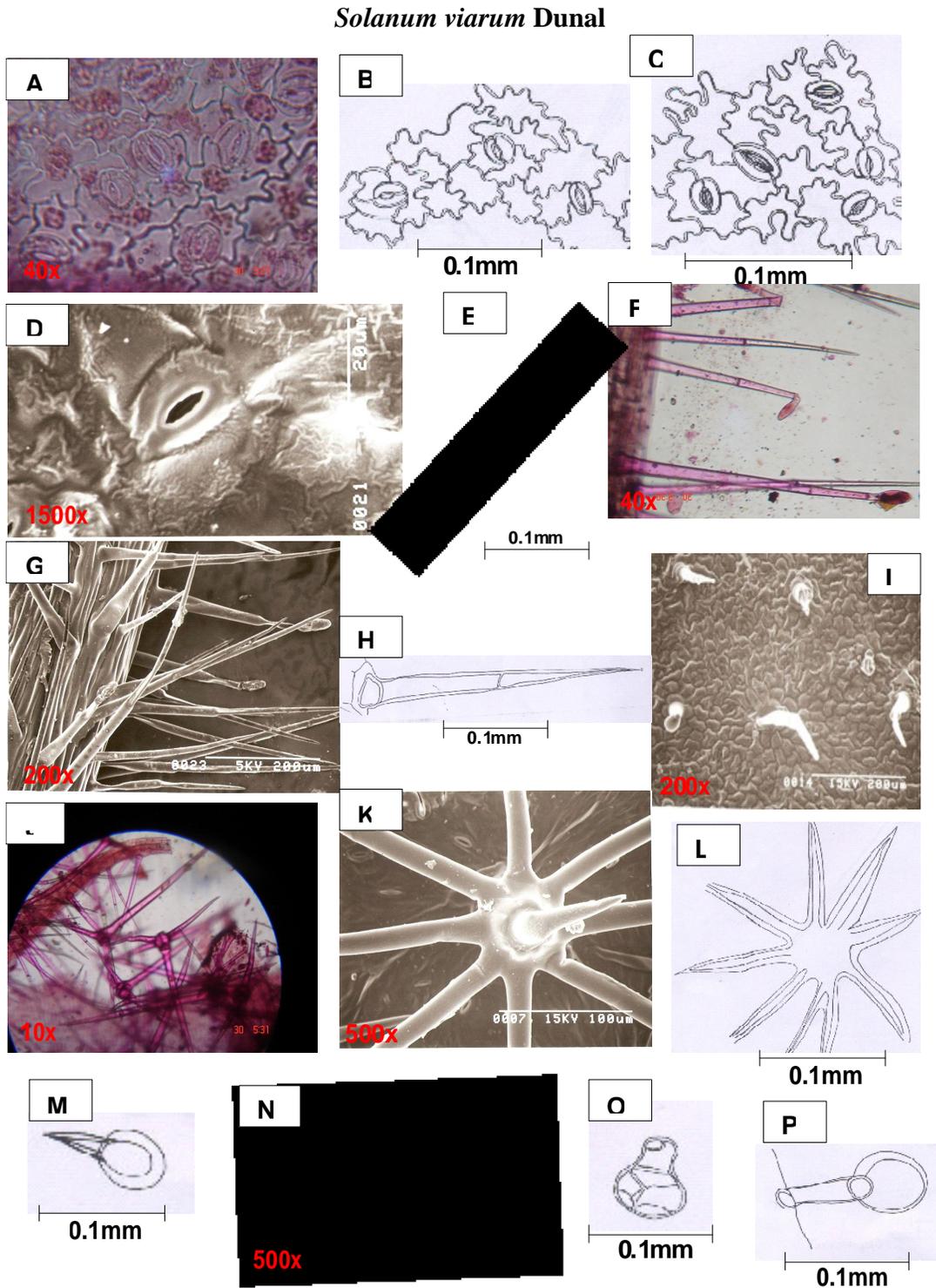
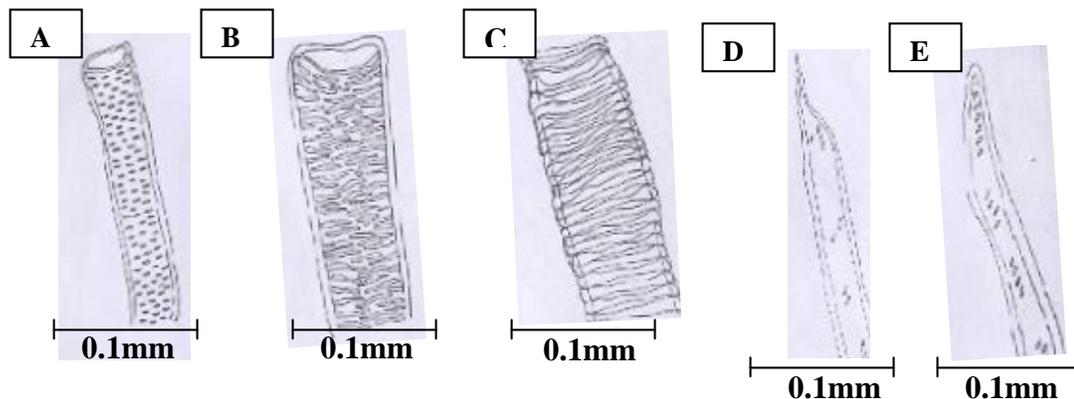


Fig.8 Wood elements: A, B- Portion of Vessel Elements; C- A portion of Tracheid; C, D- Portion of Fibres



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